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VICKERS-CARDEN-LOYD,
ARMoured MACHINE GUN CARRIER.

INSTRUCTIONS
FOR
DRIVING & MAINTENANCE.

VICKERS-ARMSTRONGS LIMITED,
LONDON, ENGLAND.

HANDBOOK NO. C.L. 20243.

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GENERAL DIMENSIONS AND DATA.

WEIGHT:- (Completely Loaded) 3 Tons. (Approx).

OVERALL DIMENSIONS:- Length. 11'- 6" Width. 6'- 9"
Height. 4'- 0"

TRACK CENTRES:- 5'- 2 $\frac{1}{4}$ "

TRACK WIDTH:- 9 $\frac{1}{2}$ "

LENGTH OF GROUND CONTACT:- 4'- 6 $\frac{3}{4}$ "

GROUND CLEARANCE:- 11"

ENGINE:- 8 Cylinder. 90° V Type L Head.
Firing Order:- 1,5,4,8,6,3,7,2.
Bore. 3 $\frac{1}{16}$ "
Stroke. 3 $\frac{3}{4}$ "
Cubic Capacity. 221 Cub.ins.
H.P. - R.A.C. Rating. 30.H.P.
Max.B.H.P. 81 at 3700 R.P.M.

GEARBOX:- Four speed and reverse.

Ratios:-	Top	Direct.
	3rd Gear.	1.69 to 1
	2nd Gear.	3.09 to 1
	1st Gear.	6.4 to 1
	Reverse.	7.82 to 1

DRIVING AXLE:- Spur Gear bevel type, with Differential.
Ratio. 5.83 to 1.

COOLING SYSTEM CAPACITY:- 5 Gallons.

OIL SUMP CAPACITY:- 1 Gallon.

PETROL TANK CAPACITY:- 2 Tanks of 10 Gallons each.
20 Gallons total.

GENERAL DESCRIPTION.

ENGINE:- The eight cylinders and crankcase are cast "en bloc", thus ensuring permanent and positive alignment of the reciprocating parts.

The crankshaft has three main bearings, and carries the connecting rods with their pistons etc. One end is fitted with a handstarting dog, a helical gear to drive the camshaft, and a pulley for "Vee" section rubber belts to drive the dynamo, fan, and water pumps.

The other end of the crankshaft is flanged for the flywheel, which transmits the engine torque to the clutch, gearbox, etc.

The contact breaker and distributor are driven directly by the camshaft. The camshaft operates the valves, through non-adjustable tappets.

Sparkling plugs, one per cylinder, are in the top of the cylinder head.

All parts of the engine are lubricated from the oil reservoir in the sump by a positive displacement gear pump to crankshaft main bearings, and camshaft bearings, and by splash to the remainder of the engine.

COOLING SYSTEM.

The engine is cooled by a circulation of water through the water jackets which surround the cylinders, combustion chambers, and valve seats. The water is circulated by thermo-syphon action, the flow of water being assisted by centrifugal water pumps located at the front of each cylinder head. These pumps draw the heated water from the engine into the upper radiator tank, from which it flows downward through numerous tubes to the lower radiator tank and back to the water jackets of the engine. An arrangement of fins around the radiator tubes effectively carries off the heat of the water as it passes through them. The heat is then radiated from these fins into the current of air drawn in by a fan, located just behind the radiator.

WATER PUMPS:- The two water pumps are of the centrifugal type, and are driven by the fanbelts.

RADIATOR:- The radiator is of the flattened tube type the cooling surface being augmented by the cross strips connecting these tubes.

FAN:- The Six bladed fan is mounted on the dynamo, and is driven by twin Vee-type belts from pulleys on the crankshaft and water pumps.

Movement of the dynamo provides the adjustment for the belts.

FUEL SYSTEM.

The petrol is drawn from the tank by the fuel pump and pumped into the carburettor, where it is mixed with air and drawn into the cylinders by piston suction.

FUEL PUMP:- The fuel pump is located on the top of the engine behind the carburettor and is driven by a push rod actuated by an eccentric on the camshaft. It draws the petrol from the tank and supplies it to the carburettor.

PETROL TANKS:- Two petrol tanks are fitted, each of 10 gallons capacity, one on either side of the vehicle. A remote control, situated on the bulkhead, allows petrol to be drawn from either tank independantly.

A filling oriface is fitted to each tank, and the petrol is drawn from the tank through a suction pipe which incorporates a filter.

Each tank has a drain plug, accessable through a cover plate bolted to the hull floor.

CARBURETTOR:- A single Zenith downdraught carburettor, type 42.V.E.I., is fitted, having a main and an auxiliary jet, by means of which the mixture strength is automatically corrected for varying speeds and throttle openings.

The carburettor incorporates an easy starting device, which is controlled by a knob situated on the bonnet.

AIR CLEANER:- From the top of the carburettor a pipe is led to the Vokes type D6440 Air Cleaner which collects dust, grit etc. which would otherwise enter the engine, to cause undue wear of the working parts.

ENGINE CLUTCH.

The clutch is of single plate, dry disc type, operated by the foot pedal, and is the medium through which the power of the engine is delivered to or cut off from the transmission.

The clutch fingers are fitted with weights which exert centrifugal force as the clutch revolves. This force is transmitted through the fingers to the clutch presser plate and assists the clutch springs in pressing the friction surfaces together. As the speed increases, so the pressure increases, and greater force is exerted at high speeds, when it is most needed. All the clutch mechanism is totally enclosed in a casting, which rigidly unites the engine and gearbox, ensuring perfect alignment of the transmission shafting.

GEARBOX.

The gearbox is of the orthodox type, and incorporates four forward speeds, and a reverse.

The clutch shaft teeth drive the layshaft gears, which are made as a unit, running on roller bearings, on a stationary shaft.

The mainshaft has a roller bearing in the clutch shaft, and at the other end, a ball bearing in the gearbox casing. The combined "top & 3rd" gears slide at the clutch end of the mainshaft, and the combined "1st & 2nd" gears at the other. The reverse idler gear combination slide on a stationary shaft.

The reverse selector is mounted in the gearbox while the other selectors, and the selector rods are in the gearbox lid.

Top speed is a direct drive from the clutch shaft to the mainshaft, while the other speeds are transmitted from the layshaft to the mainshaft, by means of sliding gears.

The gear ratios are as follows:-

Top Gear	Direct.
3rd Gear	1.69 to 1
2nd Gear	3.09 to 1
1st Gear	6.4 to 1
Reverse	7.82 to 1

COUPLING.

Enclosed in a cast housing, is a short shaft with an internal gear type universal coupling, which takes the drive from the gearbox to the bevel pinion shaft in the rear axle.

This is so designed as to require no maintenance attention, beyond a periodic inspection.

REAR AXLE.

The rear axle takes the drive from the gearbox to the tracks, and provides the means of steering and braking the vehicle. The axle consists of a bevel gear, two sprockets, two internal expanding brakes with controls, which operate in a drum to which the sprockets are attached.

The bevel pinion shaft, splined on the coupling end, runs on two taper roller bearings and a parallel roller bearing, and by means of teeth cut on it, transmits the power to the bevel gear wheel. The bevel gear wheel is riveted to the differential casing, which is in halves, and bolted together, so that it drives the differential spider, and its four pinions, which in turn rotate the axle shafts, by means of gear wheels which are splined on their ends.

The differential casing runs on two taper roller bearings mounted in the axle housing, while the differential pinions, and the inner end of the axle shaft have plain bearings on the differential spider and in the differential casing respectively. The outer ends of the axle shafts run on taper roller bearings, housed in the hub which carries the brake drum.

The gears run in oil carried in the centre housing which is provided with filling and drain plugs.

The ratio is 5.83 to 1.

BRAKE DRUMS:- Carried on the ends of the rear axle are the brake drums, in which work the internal expanding brakes for controlling the vehicle.

SPROCKETS:- Bolted on the brake drums, are the sprockets which drive the tracks. These are of specially hardened to ensure long life.

BRAKES:- The brakes fitted are of the "Girling" type, and are effectively sealed against the ingress of mud and water.

The shoes are lined with "Ferodo", and are expanded by the action of a hardened steel cone (which is actuated by the control rods); the cone operates hardened steel plungers which bear on the brake shoe ends; hardened steel rollers are interposed between cone and plungers to reduce friction to a minimum.

The cone, rollers, and shoe plungers are enclosed in a cast housing which retains an adequate supply of lubricant and protects these parts from mud, etc. This casing is slidably attached to the brake carrier by studs and nuts with spring washers.

STEERING CONTROL:- The vehicle is controlled by a steering wheel situated on the front plate immediately in front of the driver.

The first part of the movement of turning the wheel either to left or to the right, is taken by rods from an arm attached to the bottom of the steering column to a cam fixed on the cross tube. This has the effect of pushing over the track, which makes the vehicle begin to turn.

Further movement of the wheel is taken by rods to the brakes at the rear of the vehicle.

The hand brake, which is fitted with a pawl and ratchet quadrant is connected to the brake operating levers.

A foot - brake is also fitted, and the fork ends of the connecting rods are slotted where necessary to permit independant movement of the steering rods.

To steer to the right, turn the hand-wheel in a clockwise direction, and to steer to the left, turn it in an anti-clockwise direction.

To "brake" the vehicle, apply the foot-brake.

To Leave the machine with the "brakes on" apply the hand-brake.

SUSPENSION.

The suspension is of the "Slow Motion" type, with four bogie bracket assemblies, one front and one rear on each side of the vehicle.

FRONT BOGIE BRACKET:- The main fork pivots on the cross tube and is secured by a collar and clamping bolt, while the secondary fork is carried on the main fork by a spindle.

The secondary fork spindle, with a fixed and a loose collar, is fitted with rubber sealing rings to make an effective oil-tight joint. It is important that on assembly the small lip on the inner circumference of each ring should be to the inside so that the lip will be adjacent to the secondary fork.

The outer end of the spindle is tapped to enable a washer and set-screw to be used to compress the sealing rings on assembly.

In addition to a lubricator, an air relief valve is fitted to each fork to allow air to escape; this facilitates lubrication.

Two spring guide rods are fitted, one on each side of the bogie bracket centre-line. Each rod acts as a guide to four springs, two main outer and two inner auxiliary. The springs are compressed between two spring end spheres which seat in spherical fabric linings in the cups on the main and secondary forks respectively.

Rebound is limited by stop nuts fitted to the ends of the spring rods.

Two bogie wheels (rubber tyred) are carried on bogie wheel spindles in the main and secondary forks. Each is fitted with two ball bearings, separated by a distance tube.

Oil-tightness and exclusion of mud is ensured on each side by a gland with retaining and inner rings, inside which is a grease retaining plate. The spindle is retained by a slotted nut and split pin.

A top roller is carried in a bracket on the main fork, and contains two ball bearings, separated by a distance tube and, on each side, a retaining washer, gland, and cap. The roller spindle is retained by a plate and two wired set-screws.

REAR BOGIE BRACKET:- The bracket is fitted direct to the machine (one on each side of machine) supporting a sprung wheel mounted on a secondary fork. Outer springs only are fitted.

TRACK ADJUSTER:- Carried on the front of the hull are the track adjusters, and they provide the means for either tightening or slackening the tracks.

They consist of an adjustable bracket, which is mounted to the side plate by bolts, and a spring loaded pawl which engages with teeth cut on the bracket.

A spindle is provided on the bracket for carrying the Idler Wheel, so that when the bracket is moved in either direction the wheel moves with it, and so adjusting the track.

IDLER WHEEL:- This is exactly similar in design to the bogie wheel, and is retained by a slotted nut and split pin.

TRACKS:- The tracks consist of links joined together by hardened steel pins, one end of which is left soft for riveting over. Six detachable pins, drilled and fitted with a split pin and washer, are spaced in pairs round the track to facilitate breaking the track and the removal of links.

Tracks are normally fitted so that the links on the "top run" of the track (as they pass over the top roller) have their double bossed part to the front and their broad part to the rear.

The soft ends of the pins may be either on the inside or the outside of the track, but the detachable pins should have the washer and split pin to the outside to facilitate inspection.

Never oil or grease the tracks, they are designed to run dry.

ELECTRICAL EQUIPMENT.

BATTERY:- The battery is a six-volt, 100-ampere hour unit, and is carried on the near side of the vehicle beside the radiator.

DYNAMO:- The dynamo is mounted above, and to the front of the engine. Sliding of the dynamo bracket provides the adjustment for the fan belts.

STARTER MOTOR:- The starter motor is mounted on the off side of the engine. It requires no special attention beyond seeing that the connections are clean and tight, that the commutator is kept clean and the brushes are renewed when necessary.

LAMPS:- Two head-lamps, two width-indicating lamps, and a tail lamp are fitted. Provision is made, by a switch, for switching off the off-side head-lamp.

ENGINE IGNITION.

The current for igniting the fuel mixture in the cylinders is provided by the battery. The ignition coil transforms the low tension current to a high tension current of sufficient voltage to bridge the gap between the points of the sparking plugs. The contact breaker points interrupt the flow of low tension current at regular intervals, while the distributor rotor distributes the high tension current to each sparking plug in the proper firing order, which is :- 1,5,4,8,6,3,7,2.

DISTRIBUTOR & CONTACT BREAKER:- The distributor is located at the front of the engine and is driven directly by the camshaft.

The ignition timing is automatically retarded by the centrifugal governor weight springs for starting. By means of the centrifugal governor, the ignition is automatically advanced at increased engine speeds in direct proportion to the speed.

VACUUM BRAKES:- For quick acceleration, a slightly retarded spark is temporarily required and this is achieved by means of a vacuum brake consisting of a piston which is pressed against the edge of the governor plate by a spring. A tube leads from the intake manifold, and the suction normally existing there holds the piston away from the governor plate. When the throttle is suddenly opened, the suction on the piston decreases and the spring presses it against the governor plate, retarding the ignition. When the engine picks up speed, the suction again increases in the connecting tube and pulls back the piston, allowing the centrifugal governor to advance the ignition in the normal manner.

SPARKING PLUGS:- The sparking plugs which are fitted are the best adapted to the requirement of the engine, and therefore no other type should be fitted.

The gap between the points should be .030 inch.

RUNNING INSTRUCTIONS.

Precautions to be observed before starting the engine.
Check oil level in sump, by examining the dip stick on the near-side of the engine crankcase. If oil level is below the full mark, add oil of the recommended grade.

Check water level in the radiator. The correct level is when the water is just below the baffle plate, which can be seen directly under the filler.

Make sure that the gear-lever is in the neutral position.

Starting the engine from cold.

The engine should always be started from cold by hand.

Turn the petrol tap on.

Close the strangler, which operates on the air intake of the carburettor, by pulling out the knob, which is situated on the bonnet, beside the driver.

Turn the engine over several times by hand with the ignition switched off.

Switch on the ignition, and see that the strangler control is still pulled out.

Turn the engine by hand, and after a few turns the engine should fire.

Push in the strangler control as soon as it is possible without stopping the engine.

Keep the engine running slowly, until the oil warms up and circulates freely. Do not accelerate immediately from cold (except under exceptional circumstances) as excessive wear of the engine will result.

Starting the engine when hot.

Press the electric starter switch, and do not use the strangler, unless the engine fails to start readily.

The electric starter switch must not be pressed while the engine is running, or damage to the starting gear will result.

GENERAL RUNNING INSTRUCTIONS.

ENGINE:- When the engine has been started up from cold, it is advisable to let it "tick over" for a few minutes, before moving off.

Permitting the engine to idle, long enough for the valves to cool, before switching the ignition off, when the engine is operated under sustained high speeds, will materially lengthen the life of the valves.

When the engine is stopped, always make sure that the ignition is switched off, otherwise the battery discharges unnecessarily.

Never allow the vehicle to run downhill with the ignition switched off, as in consequence, the oil film on the cylinder walls and pistons will be washed away, resulting in excessive wear of these parts. Crankcase oil dilution will also result, and unburnt explosive mixture will collect in the silencers, and may cause an explosion when the ignition is again switched on.

In cold weather, running the engine for approximately one minute, before turning on the lights, will reduce the possibility of "burning out" the bulbs, owing to the dynamo charging rate overcoming the high resistance of the battery.

Always see that the strangler is operated no longer than it is absolutely necessary, as liquid petrol may be drawn into the cylinders, to wash away the lubricant, thereby causing crankcase dilution, and consequent wear of working parts.

CLUTCH:- Never drive with the foot resting on the clutch pedal, as the clutch may slip, causing premature wear on the facings, in any case, undue wear on the release bearing will result.

GEARBOX:- On starting the machine from rest, do not run the engine too fast.

The slower the engine speed when the gear is engaged, the more smoothly the machine will get away, and there will be less shock to the transmission.

When changing gear, due regard should be made to the engine speed, and move the gear-lever as far as it will go, so as to reduce wear on the gears to a minimum.

STEERING:-- The control of the steering is by the wheel, which operates the rods on the brakes. To steer to the right, turn the wheel in a clockwise direction; to steer to the left, turn it in an anti-clockwise direction.

To assist steering, and maintain speed, the throttle should be opened slightly when the wheel is turned.

At all times when steering, and particularly when travelling fast on the roads, the brakes should be applied gently to avoid sudden locking of the tracks.

When climbing a steep gradient, with a loose surface, any change of direction should be avoided if possible, as when one track is slowed up by the steering brake, the other is accelerated, due to the differential, with consequent greater risk of "track slip" starting.

LUBRICATION, MAINTENANCE, AND ADJUSTMENTS.

ENGINE

LUBRICATION:- Recommended Lubricant - Engine Oil.

Check the oil level before each run, and if necessary add oil to bring the level to the "full" mark on the dipstick.

To check the level, withdraw the dipstick, wipe it clean, and re-insert, making sure that it is pushed right down. Again withdraw the dipstick, and the mark made by the oil indicates its level.

Do not check the level immediately on stopping the engine, but allow time for the oil in circulation to drain back into the sump.

When replenishing with oil, withdraw the dipstick slightly, to allow the air in the crankcase to escape more quickly. Do not forget to push it right down afterwards, or oil will leak out.

It is advisable to clean out the sump, by draining off the oil and refilling with fresh after every 500 Miles.

CYLINDER HEAD NUTS:- After the first 150 Miles of operation, the cylinder head nuts should be tightened. After this tightening, they will require no further attention unless the head is removed.

ENGINE NOT STARTING:- If at anytime the engine fails to start, proceed as follows to isolate the cause of the trouble.

First check that the ignition has been properly switched on and that there is an adequate supply of petrol in the tank. Then disconnect the fuel pump to the carburettor line at the carburettor. If cranking the engine, either by hand, or the starter motor, does not cause petrol to flow freely from this line, sufficient fuel is not being supplied to the carburettor and the fuel pump should be checked for proper operation (see fuel pump).

A spark should be produced at each sparking plug once for every two revolutions of the engine, whether cranked by hand or the starting motor.

To test, crank the engine and hold a plug tester to the sparking plug nut; this shows a light every time a spark is produced at the plug points. If no tester is available, a wooden-handled screw-driver may be used instead and held touching the sparking plug nut and about 1/64th inches from the cylinder head. If no spark is noted, the ignition system is at fault (see ignition system).

If the engine starts but over-heats check the oil level in the engine and the water level in the radiator and replenish each as required. However, if the water is extremely low, allow the engine to cool off before adding water. The sudden contraction of the cylinders by the cold water may crack them.

COOLING SYSTEM

WATER PUMP:- The water pumps need no attention other than to see that they are kept tightly bolted to the cylinder head.

RADIATOR:- The radiator should always be kept well filled with clean water, and the fins should be kept free from dust and dirt.

FAN:- The efficiency of the cooling system depends largely on the correct adjustment of the fan belts. They should be kept moderately tight, and free from oil or grease.

The adjustment is made by loosening the dynamo support to engine clamp nut and moving the dynamo upwards. The correct adjustment is effected when, as the belt is alternately pushed and pulled at a point half-way between the water pump and crankshaft pulleys, the total movement does not exceed one inch.

Never tighten the belts more than is absolutely necessary.

FROST PRECAUTION:- When there is any likelihood of the vehicle being exposed to a temperature below freezing point the cooling system should be drained. Use the special tool for easy access to the two drain taps under the front end of the engine.

CLEANING THE COOLING SYSTEM:- The entire system should be occasionally flushed out. To do this, open the drain cocks and insert a hose in the filler, allowing the water to flow through the system for about 15 minutes or until the water comes out clear.

FUEL SYSTEM.

FUEL PUMP:- The construction of the pump is such as to provide a trap for sediment or water, which can be drained off by means of the drain plug on the side of the pump, after loosening the inlet pipe union (immediately above the drain plug).

If it is desired to clean the pump screen, it may be easily reached by unscrewing the screw in the centre of the pump cover and removing the cover. When replacing the cover, always make sure that the cover gasket is not broken, the filter is correctly located and that the cover is seating properly.

If at any time the carburettor is not receiving sufficient petrol, one of the following is likely to be the cause:-

(1) Petrol tank is empty.

(2) Screen in the top chamber of the fuel pump has become fouled with sediment, in which case it should be cleaned (see above).

(3) The petrol line or its connections have a leak at some point, permitting the entrance of air to the line. The remedy of course is to stop the leak, at which time the pump will prime itself and again function properly. Cranking the engine for 20 seconds with the starter should prime the pump.

(4) If at any time petrol is seeping through the small holes in the lower half of the fuel pump, it is probably an indication of the diaphragm in the pump having become fractured. While this does not usually render the pump inoperative immediately, it is advisable to replace the diaphragm as soon as possible.

PETROL TANK:- The tank should occasionally be completely removed, washed out with petrol and replaced. This gets rid of all the sediment which may have collected in the tank.

CARBURETTOR:- For adjustments see makers handbook.

AIR CLEANER:- The air cleaner should be removed periodically, and the element removed and shaken free of all dust and dirt.

ENGINE CLUTCH:- The clutch release bearing is of the self-lubricating type and should require no attention. It is however important that the clutch pedal adjustment be maintained at all times; the clearance between the clutch release bearing and the clutch operating fork being indicated by the amount of free travel of the clutch pedal. As the clutch disc facings become worn, it will be necessary to adjust this clearance. The correct adjustment is when the clutch pedal has $1\frac{1}{2}$ to 2 inches free movement. Adjustment is made by altering the length of the rod from the clutch pedal, by removing the pin and split pin, screwing the fork end and its lock nut as required, until the correct adjustment is obtained. Make sure that all pins and split pins are replaced, and that the lock-nuts are tight when completed.

Note:- The clutch is of the dry disc type and under no circumstances should it be oiled.

LUBRICATION

GEARBOX:- Recommended Lubricant:- Gear Oil.

Every 500 Miles, sufficient gear oil should be added to bring it level with the filler hole on the right hand side of the gear box.

The oil should be drained off every 2500 Miles, by removing the drain plug in the bottom of the gearbox. The interior of the gearbox should then be thoroughly flushed with paraffin and refilled with fresh gear oil.

REAR AXLE:-

Recommended Lubricant:- Extreme Pressure Gear Oil.

Every 500 Miles, add sufficient gear oil to bring it level with the filler hole on the right hand side of the differential housing.

The oil in the axle should be drained off every 2500 Miles by removing both plugs in the axle housing and the housing flushed with paraffin. Fresh oil should then be added until it reaches the level of the upper oil filler hole in the housing.

BRAKES:- Adjustment for brake lining wear is obtained by rotation (in a clockwise direction) of a hardened steel cone (this cone has four flats of a pre-determined depth machined on its face). The cone engages the two plungers, also with inclined flat faces, on which the shoes are fulcrumed. The cone spindle is screwed with a fine thread and located in a steel housing firmly spigoted and bolted to the backplate; this housing also carries the two plungers. Rotation of the cone causes it to move outwards, forcing apart the plungers and expanding the ends of the shoes.

The flats on the cone face perform two useful functions:-

(a) The action of the brake shoe springs on the plungers serves to lock the cone in position when the adjustment is carried out.

(b) The depth of the flats is such that they allow exactle the correct amount of shoe clearance in the drum when adjusted.

Before commencing the forgoing adjustment, see that the brake lever is in the off position.

The brakes should be adjusted so that the drum can be turned without the shoes binding.

Recommended Lubricant:-Duckham's Keenol Grease.K.G.20

SUSPENSION:- Recommended Lubricant:- M.800 and M.265.

Every 100 Miles, or after running in mud, the Bogie wheels, Top Rollers, Bogie Brackets, and Idler Wheels, should be lubricated with M.800, until the lubricant exudes, as this will force out any mud or water that has entered.

Every week the secondary fork bearings should be lubricated with M.265 until the lubricant exudes from the air relief valve.

Note:- The spring end spheres and fabric linings should not be lubricated as best results are obtained if these are run dry.

TRACKS:- Adjustment of tracks to the correct tension is of importance. If too tight, excessive wear will result, whilst if too slack, there will be risk of them coming off when turning across country.

The ingress of mud or wet sand into the hinged joints of a track reduces its effective length and increases its tension.

It is necessary therefore, to consider the probable state of the ground over which the vehicle may operate and make allowances when adjusting "clean" tracks, i.e., the hinged joints of which are clean as a result of road running or after being washed with a high pressure hose.

The ideal track tension is such that when all the slack is collected on the "top run" of the track, there is a sag of approximately $1\frac{1}{2}$ ins. between the top roller and the Idler Wheel.

If the tracks are adjusted when "clean" before running in mud, they should be slacked until the amount of sag is approximately 2 ins. to allow for the ingress of mud.

To adjust the track, loosen the three nuts which hold the bracket to the side plate.

Insert the adjuster tool between the back plate and the bracket and pull up. This will draw the bracket back on the pawl, and so tightening the track. Release the handbrake lever, as by allowing the sprocket to turn, the tension of the track on either side of the sprocket will be equalised. If this is not done, all the slack may be in the part of the track between the first bogie wheel and the sprocket, making it difficult to estimate the tension.

BALANCING TRACKS:- Tracks are issued in pairs, i.e., they are of the same length, therefore the pitch of the links (or distance between pin centres) is the same.

As the rate of wear in each track may be different, it is obvious the pitch of one track may gradually become greater than that of the other. Should this be so, the vehicle will no longer steer straight, but gradually turn to the side of the short pitched track.

To compare the pitch of two tracks, the number of links in each track must be equal. Then, when stretched taut on the ground the longer track will be of longer pitch, a difference of 1 inch in total length being sufficient to cause faulty steering.

The track can be balanced by breaking into quarters and changing over alternate quarters, so that when joined up each track will be the same length, with the same number of links, and consequently of the same average pitch.

To remove a track, run the track so that a detachable pin is in front of the sprocket, slacken off the adjustment as necessary, remove the split pin and washer, and drive out pin with track pin punch.

ELECTRICAL EQUIPMENT

BATTERY:- Every 250 Miles, or fortnightly, check the electrolyte in the battery to see that it is at the proper level, i.e., $\frac{3}{8}$ Inch above the top of the plates. If below this point, add distilled water until the electrolyte reaches the proper level. In cold weather, add water only immediately before running the engine so that the charging will mix the water and electrolyte and prevent freezing.

Check that the terminals are clean, tight and coated with vaseline.

If at any time the battery is removed from the vehicle see that the "positive" terminal is earthed to the vehicle on replacement.

DYNAMO:- The ideal charging rate, is the lowest rate with which the full charge is maintained.

To increase or decrease the charging rate, remove the cover and move the third brush. This is the one just on the left of the top centre-line. To increase the charging rate, move the brush in the direction of rotation; to reduce the rate, move the brush in the opposite direction. For average driving, the charging rate should not exceed 10 amperes, as shown on the ammeter.

The commutator should be kept clean and the brushes renewed when necessary.

Lubricate the dynamo bearings every 500 Miles by filling the cups at each end with engine oil.

STARTER MOTOR:- See that the connections are kept clean and tight, that the commutator is kept clean and the brushes renewed when necessary. No lubrication is required.

ELECTRIC HORN:- To adjust the horn, slack the lock-nut on the adjusting lever at the back, press the horn button and turn adjusting lever in off direction until the motor can be heard rotating. Turn back lever in opposite direction sufficiently to obtain the correct note, but do not turn farther than necessary, again tighten lock-nut.

ENGINE IGNITION:- Means of adjusting the timing of the ignition, to meet the requirements of the fuel used, are provided by the vacuum brake adjusting screw.

Adjustment is obtained for the particular fuel used as follows:-

Loosen the adjusting screw lock-nut. Unscrew the adjusting screw until the engine "pings" under load. Then turn the adjusting screw in just enough to remove the "ping", and tighten the lock-nut to preserve the adjustment.

If trouble should be experienced, which by the process of elimination, as covered by "engine not starting", appears to be the result of faulty ignition, proceed as follows:-

- (1) Disconnect the red wire from the coil.
- (2) Turn ignition switch to "on" position.
- (3) Touch disconnected wire to cylinder. If spark does not occur, check each wire and connection back through the battery to the battery earth for a break in the circuit.
- (4) If a spark occurs when the ignition switch to coil wire is "earthed" to the cylinder, remove the distributor side covers and examine the breaker points. If the points are worn, pitted, burned or incorrectly spaced, dress them smooth with an oil stone. Adjust the gap to .012 to .014 inch with the fibre breaker arm on the high point of the cam. (Badly burned breaker points are usually an indication of condenser trouble or a poor battery connection).
- (5) If the trouble has not been corrected, remove the distributor terminal plates and side covers. Turn on the ignition. Earth a wooden handled screw-driver to the distributor body, holding the end of the screwdriver blade approximately $\frac{3}{8}$ in. from the metal band around the centre of the rotor.

When the engine is cranked, a spark should occur between the rotor and the screwdriver. If a $3/8$ in. spark occurs regularly, further tests of the primary circuit and the coil can be eliminated.

If a spark of less than $3/8$ in. only can be obtained, it is probable that the rotor, condenser or coil is short circuited.

If no spark is seen, the primary circuit is not completed at some point within the distributor.

If a satisfactory spark is obtained at the rotor and no spark is noted at the plugs, the sparking plug wires, terminal plates or distributor side covers are short circuited, probably due to the engine having been operated at some time with one of the sparking plug wires disconnected from either the plug or the terminal plate.

To isolate the part at fault, while the engine is cranked hold each sparking plug wire (Plug End) $3/8$ in. away from the cylinder head. Any wire from which the spark bridges this $3/8$ in. gap is satisfactory and can be eliminated from further tests. Any wires failing to meet this test should not be condemned until terminal plates and side covers are examined for evidence of leakage, and no such evidence is found.

(6) Check the gap between the sparking plug points. Clean the plugs and adjust to .030 inch.

Every 500 Miles, fill the oil cup on the distributor with engine oil, and smear a light film of vaseline over the cam.

GENERAL LUBRICATION:-

Every 250 Miles, or fortnightly, lubricate all control joints, connections, etc.



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